Magnetic Circuit Units Adopted by I. E. C.

Standardized designations already adopted will obviate confusion if generally ratified; further international standardization of electromagnetic nomenclature is urged.

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At a plenary meeting of the International Electrotechnical Commission (I. E. C.) held in Scandinavia in the summer of 1930 was conducted a series of international committee meetings on the subject of electric and magnetic units. Agenda for that series of meetings had been prepared and distributed internationally many months in advance. In America a subcommittee on magnetic units of the U. S. national committee of the I. E. C. had held a number of meetings in New York, had prepared duly approved agenda for Scandinavia, and had distributed the same among the other national committees abroad.

Ever since the electrical congress at Paris adopted the C. G. S. magnetic units *maxwell* and *gauss* in 1900, there has been a growing confusion in international electrotechnical literature as to the proper use of the unit *gauss*. Some writers used the *gauss* as the unit for magnetizing force $\mathcal{H}$, others used it for magnetic flux density $\mathcal{B}$, and still others used the *gauss* for both $\mathcal{H}$ and $\mathcal{B}$ indiscriminately. This vagueness and lack of uniformity was not confined to the literature of any single country; it was found in that of all or nearly all countries and the confusion may be said to have become universal. There was, however, universal agreement upon the internationally accepted equation

$$\mathcal{B} = \mu \mathcal{H} \qquad (1)$$

where $\mathcal{B}$ is the flux density in a magnetizable medium, $\mathcal{H}$ the magnetizing force, and μ the permeability of the medium. In the case of a vacuum, or free space—*i. e.*, non-magnetic material—the same equation becomes

$$\mathcal{B} = \mu_0 \mathcal{H} \quad \text{gausses} \qquad (2)$$

where μ_0 is the permeability of free space, which admittedly is equal numerically to unity in the C. G. S. magnetic system.

In equation (**2**), if space permeability μ_0 is a mere number unity, then both $\mathcal{B}$ and $\mathcal{H}$ are expressible in *gausses*; but if μ_0 has physical dimensions and is not a mere unit number, then $\mathcal{B}$ is expressible in *gausses* but $\mathcal{H}$ is different, and is expressible in some other unit.

The I. E. C. Scandinavian meeting decided unanimously in favor of the electrotechnical convention that μ and μ_0 are physical quantities and not mere numerics, and that $\mathcal{B}$ only should be expressed in *gausses*. For the expression of $\mathcal{H}$, a new unit name was adopted; namely, the *oersted*. In fact, Oersted was the Danish physicist who discovered at Copenhagen in 1820 the experimental fact, previously unsuspected, that a wire carrying an electric current exercises a deflecting magneto-mechanical torque or couple upon the poles of a suspended magnetic needle.

After reviewing the I. E. C. decisions on magnetic units as made at Oslo, recommendations for future consideration and discussion are made as follows:

(1) The I. E. C. decisions at Oslo to be ratified and generally adopted, thus eliminating confusion among magnetic units in the future.

(2) Another C. G. S. magnetic unit for reluctance might advantageously be adopted in the future. In America the *oersted* was used very generally as the unit of magnetic reluctance, but this had never been adopted internationally and the assignment of the *oersted* to magnetizing force $\mathcal{H}$ leaves a gap in the series of units expressing magnetic Ohm's law.

(3) A series of magnetic units in the practical or *volt-ampere-ohm* system might advantageously be considered in the future, commencing with the *pramaxwell* adopted at Oslo; but that before attempting any further international action on practical magnetic units, certain preliminary questions as to rationalization and also the particular system to be adopted, should first be studied, formulated, and internationally settled. This necessarily will take time.

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From "Magnetic-Circuit Units as Adopted by the International Electrotechnical Commission" (**No. 31-7**) presented at the A. I. E. E. winter convention, New York, Jan. 26-30, 1931.